Wireless Microphone
Antenna Efficiency & Body Absorption Study

(Test conducted: Sept. 2004)
Reported: September 2007

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Antenna Efficiency & Body Absorption Study

- Shure conducted measurements in September of 2004* to quantify the effect of antenna efficiency and body absorption on wireless microphone propagation
  - Microphone transmitter antennas that are body-worn or handheld typically have much less than 0dBi gain
  - Body absorption and shadowing attenuate the transmitter signal significantly and reduce link margin

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Note: These study results were reported in the Shure Comments (04-186), filed with the FCC in Nov. 2004

Antenna Efficiency & Body Absorption Study

- Measured six wireless microphone transmitters in total
  - Four UHF and two VHF
    - Subdivided into three handheld and three body-pack models Measurements conducted in open-area, outside grass field at a distance of 30 meters
  - Transmitters were at 1 meter for body-packs and 1.4 meters for handhelds
  - Receiver antennas were at 2 meters above ground (0dBi gain)
- Measured signal strength compared against free-space path loss of 30 meters
  - Difference is sum of antenna efficiency + body absorption effect

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Free-Space Calculations

Unit	Freq.	Pout (dBm, conducted)
UHF #1 (HH)	790.75 MHz	12.5
UHF #2 (BP)	790.75 MHz	11
UHF #3 (HH)	569.65 MHz	11.2
UHF #4 (BP)	569.65 MHz	10.5
VHF #5 (HH)	169.445 MHz	15.5
VHF #6 (BP)	169.445 MHz	15.1

- Pout (dBm) = Conducted microphone transmitter output power
- Calculate free-space path loss at 30 meters
- Subtract (Pout – PL) to get expected received signal level in free-space at 30 meters

Unit	Freq.	Pout (dBm, conducted)	PL - Free Space 30 meters (dB)
UHF #1 (HH)	790.75 MHz	12.5	60.1
UHF #2 (BP)	790.75 MHz	11	60.1
UHF #3 (HH)	569.65 MHz	11.2	57.3
UHF #4 (BP)	569.65 MHz	10.5	57.3
VHF #5 (HH)	169.445 MHz	15.5	46.7
VHF #6 (BP)	169.445 MHz	15.1	46.7

Unit	Freq.	Pout (dBm, conducted)	PL - Free Space 30 meters (dB)	Expected Receive Level in Free Space (dBm)
UHF #1 (HH)	790.75 MHz	12.5	60.1	-47.6
UHF #2 (BP)	790.75 MHz	11	60.1	-49.1
UHF #3 (HH)	569.65 MHz	11.2	57.3	-46.1
UHF #4 (BP)	569.65 MHz	10.5	57.3	-46.8
VHF #5 (HH)	169.445 MHz	15.5	46.7	-31.2
VHF #6 (BP)	169.445 MHz	15.1	46.7	-31.6

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Measurement Results

- The transmitter signal strength was measured using a 0dBi receive antenna
  - Handheld and body-pack transmitters were measured at a 30 meter distance (line-of-sight) to the stationary receive antenna
  - Person holding/wearing the transmitter stood and slowly turned in a circle with the transmitter on
    - Maximum and minimum signal levels were recorded using a spectrum analyzer at the receive antenna while the person rotated from 0-360 degrees*

Unit	Freq.	Pout (dBm, conducted)	PL - Free Space 30 meters (dB)	Expected Receive Level in Free Space (dBm)	Maximum Receive Level (dBm)	Minimum Receive Level (dBm)
UHF #1 (HH)	790.75 MHz	12.5	60.1	-47.6	-46	-66
UHF #2 (BP)	790.75 MHz	11	60.1	-49.1	-57	-92
UHF #3 (HH)	569.65 MHz	11.2	57.3	-46.1	-52	-75
UHF #4 (BP)	569.65 MHz	10.5	57.3	-46.8	-54	-77
VHF #5 (HH)	169.445 MHz	15.5	46.7	-31.2	-72	-86
VHF #6 (BP)	169.445 MHz	15.1	46.7	-31.6	-82	-86

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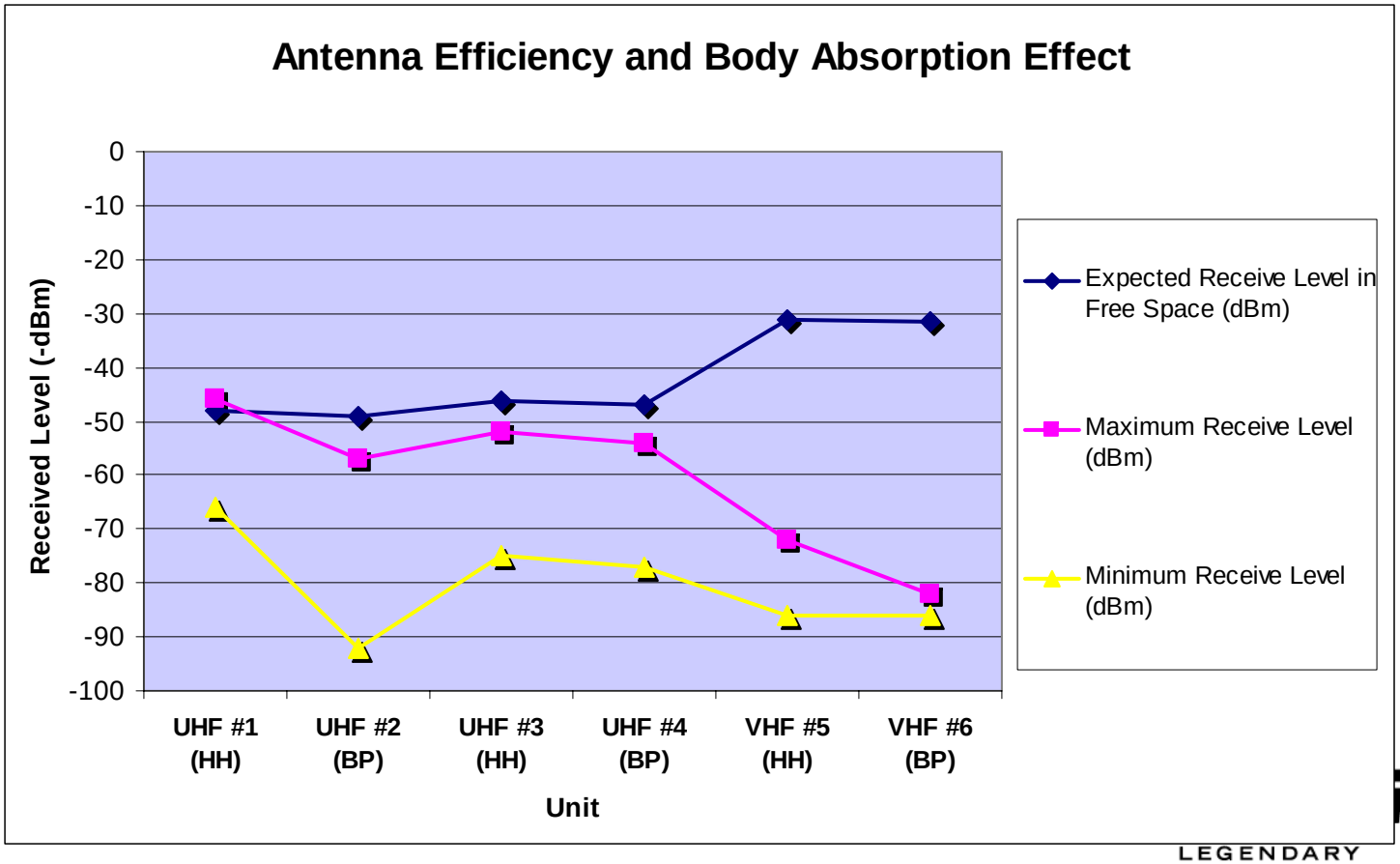
Note: Received signals that were subject to multi-path propagation were not recorded.

Measurement Results

- Average attenuation from body absorption over four units at **UHF is –17.9 dB**
- Average attenuation from body absorption over two units at **VHF is –50.1 dB**



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Measurement Setup

0dBi Receive Antenna

Person w/ Handheld Transmitter

Data taken from file:

http://stellent/stellent/idcplg?IdcService=GET_FILE&dID=56239&dDocName=050347&allowInterrupt=1

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